a plurality of photosensitive devices arrayed at a certain pitch, formed with semiconductor layers deposited on said substrate, and isolated from each other;

an output signal line commonly connected to terminal electrodes of said plurality of photosensitive devices; and

a detection circuit connected to said output signal line, wherein a light spot is radiated as a light pulse to determine a light spot position from a delay time of a detection output from said detection circuit after said light pulse irradiation.--

--26. The light spot position sensor according to claim 25, further comprising a scanning detector for sequentially scanning output signals from said plurality of photosensitive devices to detect a light spot position.--

--27. The light spot position sensor according to claim 26, wherein said plurality of photosensitive devices configures a photosensitive device array arranged one-dimensionally.--

REMARKS

Claims 6-27 are pending. By this Amendment, the Abstract is replaced with a substitute Abstract, the specification has been amended to correct minor informalities, claims 1-5 have been canceled without prejudice or disclaimer, and claims 22-27 have been added. Reconsideration based on the above amendments and following remarks is respectfully requested.

The attached Appendix includes marked-up copies of each rewritten paragraph (37 C.F.R. §1.121(b)(1)(iii)).

I. The Drawings Satisfy All Formal Requirements

The Office Action objects to Fig. 9 due to inconsistency of reference signs with respect to the specification. The specification is amended to obviate the objection. Withdrawal of the objection to Fig. 9 is respectfully solicited.

II. <u>The Claims Define Allowable Subject Matter</u>.

The Office Action rejects claims 1-2 and 4-5 under 35 U.S.C. §102(b) over U.S. Patent No. 4,521,106 to Lambeth. This rejection is moot with respect to claims 1, 2, and 4 because these claims have been canceled without prejudice or disclaimer. This rejection is respectfully traversed with respect to claim 5, which corresponds to new claim 25.

The Office Action asserts that Lambeth discloses the subject matter recited in claim 25 (corresponding to rejected claim 5). However, Applicant respectfully submits that Lambeth does not disclose determining a light spot position from a delay time of a detection output, as recited in claim 25.

Lambeth discloses a linear array of photosensors 18, which produce signals analyzed by control electronics 20 to determine the position of an illuminated spot in a scene and produce a signal representing the distance to the object. By comparing the outputs of the photosensors to determine which photosensor has the maximum output, the location of the illuminated spot in the scene and thereby the distance to the object can be determined. (See col. 1, lines 47-66; Fig. 1.) Lambeth does not disclose any other technique for determining a light spot position. Thus, Lambeth does not disclose determining a light spot position from a delay time of a detection output as recited in claim 25. Withdrawal of the rejection of claims 1-2 and 4-5 is respectfully solicited.

Claim 3 is rejected under 35 U.S.C. §103(a) over Lambeth in view of Application Publication No. JP 2001-50778 to Aoki. Claim 3 corresponds to new claim 22. This rejection is respectfully traversed.

The Office Action admits that Lambeth does not disclose a plurality of photosensitive devices including a first photosensitive device array arranged on a substrate along a first axis and a second photosensitive device array arranged on the first photosensitive device array with an interlayer insulator therebetween, along a second axis different from the first axis, but

asserts that Aoki supplies the subject matter lacking in Lambeth. Applicant respectfully submits that Aoki is not prior art. The inventor of the present application and the Aoki publication are the same person, Toshihiko Aoki. The Aoki publication was published on February 23, 2001 which is less than one year from the filing date of the present application (July 9, 2001). MPEP §2132.01 states, "Applicant's disclosure of his or her own work within the year before the application filing date can not be used against him or her under 35 U.S.C. §102(a)." Further, since Aoki was published less than one year before the filing date of the present application, Aoki is not prior art under 35 U.S.C. §102(b). MPEP §715.01(c) states, "Unless it is a statutory bar, a rejection based on a publication may be overcome by a showing that it was published by Applicant himself/herself or on his/her behalf." Since Aoki is not prior art and the Office Action admits Lambeth does not disclose the subject matter of claim 3, this rejection is moot. Withdrawal of the rejection of claim 3 under 35 U.S.C. §103(a) is respectfully requested.

Claims 6-7, 9-15, and 17-21 are rejected under 35 U.S.C. §103(a) over U.S. Patent No. 5,671,052 to Kawakubo et al. (hereinafter "Kawakubo") in view of Lambeth. This rejection is respectfully traversed.

Claims 6-13

The Office Action asserts that surface-emitting laser 133 and photodetector 134 (Fig. 13) show the state detection system of claims 6-13. However, a light emission element 133 and photodetector 134 merely constitute a detector for detecting the movement of a linear scale 135 (col. 7, lines 53-61). Kawakubo does not detect relative positional state. Thus, Kawakubo does not disclose "a state detection system mounted on said sensor head for optically detecting a relative positional state of said sensor head to said scale...," as recited in claim 6.

The Office Action asserts that it would have been obvious to one of ordinary skill in the art to substitute the image sensor of Lambeth for the photodetector in Kawakubo. Applicant respectfully submits that one of ordinary skill in the art would not have been motivated to combine Lambeth with Kawakubo.

Kawakubo teaches providing a high-resolution encoder without a conventionally-used lens for use in beam shaping (Column 7, lines 59-61). On the other hand, Figure 1 of Lambeth teaches the use of lenses, which project light onto the linear array of photosensors (Column 1, lines 41-53). Since Lambeth's linear array of photosensors requires the conventional lens system, one of ordinary skill in the art would not have been motivated to combine Kawakubo and Lambeth. Instead, if combined either Lambeth or Kawakubo would be rendered inoperative for its intended purpose.

In view of the above, the Office Action is engaging in impermissible hindsight reconstruction using this application as a road map to pick and choose features from the prior art. Accordingly, Lambeth and Kawakubo, individually, would not have rendered obvious the subject matter recited in claim 6.

Since claims 7-13 depend directly or indirectly from claim 6, claims 7-13 are distinguishable from Kawakubo and Lambeth for the same reasons. Therefore, Lambeth and Kawakubo, individually, would not have rendered obvious the subject matter recited in claims 7-13. Therefore, withdrawal of the rejection of claims 6-13 under 35 U.S.C. §103(a) is respectfully requested.

Claims 14-21

The Office Action admits that Kawakubo does not teach a light spot position sensor including a substrate; and a plurality of photosensitive devices arrayed at a certain pitch, formed with semiconductor layers deposited on said substrate and isolated from each other as recited in claims 14-21, but asserts that Lambeth teaches this subject matter. However, as

discussed above in connection with claim 6, Applicant respectfully submits that one of ordinary skill in the art would not have been motivated to combine Lambeth with Kawakubo. Therefore, Lambeth and Kawakubo, individually, would not have rendered obvious the subject matter recited in claims 14-21. Withdrawal of the rejection of claims 14-21 under 35 U.S.C. §103(a) is respectfully requested.

Claims 8 and 16 are rejected under 35 U.S.C. §103(a) over Kawakubo in view of Lambeth and Aoki. This rejection is respectfully traversed.

Applicant respectfully submits that Aoki is not prior art as discussed above with respect to new claim 22 above. Since Aoki is not prior art and the Office Action admits that Lambeth and Kawakubo fail to disclose the subject matter of claim 3 (corresponding to new claim 22), this rejection is moot. Withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully requested.

III. Conclusion

For at least these reasons, it is respectfully submitted that this Application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 6-27 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this Application in better condition for allowance, the Examiner is invited to contact Applicant's undersigned representative at the telephone number listed below.

Respectfully submitted,

Paul F. Daebeler

James A. Oliff
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JAO:PFD/sxb

Attachments:
Appendix
Abstract

Date: April 15, 2003

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Alexandria, Virginia 22320
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DEPOSIT ACCOUNT USE AUTHORIZATION Please grant any extension necessary for entry; Charge any fee due to our Deposit Account No. 15-0461

APPENDIX

Changes to Abstract:

The following is a marked-up version of the amended Abstract.

There is provided a displacement measuring device of which assembled state can be determined optically with ease. There is also provided a light spot position sensor usefully applicable in determination of ~~such~~ the assembled state of the displacement measuring device. An optical encoder comprises a scale ~~(5)~~ and a sensor head ~~(54)~~ that is arranged opposite to the scale and can move relative to the scale. The sensor head ~~(54)~~ includes a sensor substrate ~~(52)~~, on which an index gra~~n~~ting ~~(55)~~ and a photosensitive device array ~~(56)~~ are formed. The sensor substrate ~~(52)~~ is also employed to mount a light spot position sensor ~~(2)~~ and a light source ~~(57)~~ for providing a light beam entering the light spot position sensor ~~(2)~~ via the scale ~~(5)~~ to configure a state detection system for detecting an assembled state.

Changes to Specification:

Page 3, line 28 - page 4, line 1:

Preferably, the displacement measuring device may also comprise a detector~~detection means~~ for detecting a surface feature of the work based on a position of the light beam detected at the light spot position sensor, the light beam output from the light source and entering the light spot position sensor via the work.

Page 4, lines 2-12:

Preferably, the displacement measuring device may further comprise a displacement device arranged on the cantilever for displacing the tip of the cantilever in the direction opposite to the work; a displacement controller ~~means~~ for feedback controlling the displacement device so that a position of the light beam detected at the light spot position sensor always comes to a constant position, the light beam output from the light source and entering the light spot position sensor via the work; and a detector~~detection means~~ for

detecting a surface feature of the work based on a feedback signal from the displacement controller ~~means~~ to the displacement device.

Page 5, lines 18-19:

Figs. 14A and 14B illustrates the principle of tilt detection by the position sensor;

Page 5, lines 20-21:

Figs. 15A and 15B illustrates the principle of gap detection by the position sensor;

Page 5, lines 24-27:

Figs. 17A and 17B illustrates an arrangement of an index substrate in an optical encoder according to a further embodiment and the principle of tilt detection thereof;

Page 5, lines 27-28:

Figs. 18A and 18B shows other examples of photosensitive device patterns for use in the position sensor;

Page 5, lines 29-30:

Figs. 19A and 19B shows a main part of a non-contact cantilever using a two-dimensional position sensor;

Page 5, line 31:

Figs. 20A and 20B shows states of the cantilever in use;

Page 6, lines 1-2:

Figs. 21A - 21E shows several examples of a positional relation of the position sensor to the light source;

Page 6, lines 3-4:

Figs. 22A and 22B shows a non-contact cantilever containing a displacement device formed therein;

Page 6, lines 5-6:

Figs. 23A and 23B shows a non-contact cantilever of vertical incident type; and

Page 6, line 7:

Figs. 24A and 24B shows states of the same cantilever in use.

Page 11, lines 5-14:

Fig. 9 shows an arrangement of an optical encoder. This optical encoder comprises a scale 50 and a sensor head 54 movably arranged relative thereto, opposing to the scale. The scale 50 in this embodiment is of reflective type and has scale markings or optical gratings 51 formed along a measurement axis x on a scale substrate. The sensor head 54 includes a sensor substrate 52 and a light source 53 . On the sensor substrate 52 , index gratings 55 for modulating a light emitted from the light source and advancing to the scale 50 and a photosensitive device array 56 for detecting a light from the scale 50.

Page 11, lines 15-31:

The light spot position sensor 2 as previously described in Figs. 3 and 4 and a light source 57 for providing a light beam are mounted on both sides of the sensor substrate 52 in the sensor head 54 sandwiching the photosensitive device array 56. A state detector 58 for detecting the assembled state of the scale 50 and sensor head 54 from the light spot position detected at the light spot position sensor 2 is provided to configure a state detection system. The light beam from the light source 57 enters the scale 50 at a tilt and the light beam reflected from the scale 50 enters the position sensor 2. In this case, the scale gratings 51 may be formed on the side portion of the scale 50, to which the light beam from the light source 57 enters and a light reflected from the grating surface enters the position sensor 2 . Alternatively, if the scale gratings 51 are not formed on the side portion, a reflective film may be formed continuously along the length of the scale 50 instead of the scale gratings 51.

Page 12, lines 4-10:

The light source 57 may be configured as shown in Fig. 10. In this example, a laser diode 60 is located on the sensor substrate 52 to output a light beam laterally. The output light

beam is reflected at a mirror 62 then passes through the sensor substrate 52 and enters the scale 50 at a tilt. The~~Such the~~ mirror 62 can be formed easily with the recent micro-machining technology.

Page 12, lines 11-16:

Fig. 11 shows another arrangement of the light source 57. In this example, a laser diode 60 is located on a surface of a sensor substrate 52 facing to the scale. The light beam output laterally from the laser diode 60 is reflected at a mirror 63 and enters the scale 50 at a tilt. The mirror 63 may have a reflective surface of concave mirror type to serve also as a lens.

Page 12, line 24 - page 13, line 3:

Thus, the assembled state of the optical encoder can be detected by the position sensor 2 and light source 57 mounted on the sensor substrate 52. For example, Fig. 14A shows a normal state (dotted line) of the sensor substrate 52 that is arranged in parallel with the scale 50 and a tilted state (continuous line) of the sensor substrate 52 that is arranged at a tilt. The normal state differs from the tilted state in an incident position of a light beam into the position sensor 2 from the light source 57 as shown in Fig. 14B. Accordingly, a degree of the tilt of the sensor head can be determined by detecting the light spot position.

Page 13, lines 4-11:

Fig. 15 shows a variable air gap between the sensor head and the scale ~~s~~50. For example, the gap depicted with a dotted line in Fig. 15A is assumed in a normal state. If the gap reduces as depicted with a continuous line, an incident position of a light spot into the position sensor 2 varies as shown in Fig. 15B. Accordingly, detection of the light spot position can determine a magnitude of the gap between the sensor head and the scale.

Page 13, lines 22-29:

In the above embodiments, the light beam from the light source 57 enters the scale 50 at a tilt and the reflected light beam therefrom is detected at the position sensor 2. In another arrangement, the light from the light source 57 may enter the scale 50 at a right angle. Fig. 17 shows such an arrangement. A light spot position sensor 2 is located along one side of a sensor substrate 52 in the sensor head. In addition, a light source 57 is located near the center of the position sensor 2.

Page 13, line 30 - page 14, line 7:

In the above arrangement, if the sensor substrate 52 is parallel with the scale 50 as depicted with a dotted line in Fig. 17B, the light beam from the light source 57 enters the scale 50 substantially at right angle and the light reflected therefrom returns along the same path. When the scale 50 tilts as depicted with a continuous line, the light beam enters the scale 50 at a tilt and shifts the position of the spot that enters the position sensor 2. Therefore, the tilt of the sensor head can be determined by detecting this positional deviation.

Page 15, lines 20-31:

The optical encoder described above employs the main light source 53 to illuminate the scale for use in displacement detection and the light source 57 for the light spot position sensor. The light source 57 for the light spot position sensor provides a light beam like a laser diode does. Accordingly, it is easy to control the light source 57 so as not to badly affect on displacement detection. To the contrary, the main light source 53 for displacement detection provides an output light that extends to a certain range and enters the scale 50. Therefore, if the light reflected from the scale enters the light spot position sensor, it turns into a possible noise for displacement detection.

Changes to Claims:

Claims 1-5 are canceled.

Claims 22-27 are added.